

ECOLOGICAL ASPECTS OF *ARETHUSA BULBOSA*,
CALOPOGON TUBEROSUS AND
POGONIA OPHIOGLOSSOIDES (ORCHIDACEAE) IN
EASTERN NEWFOUNDLAND.
II. PARTITIONING OF THE MICROHABITAT

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ABSTRACT

Three sympatric species of peatland orchids were investigated for differences in their ability to partition microhabitats. Species distributions at the study sites reflected differences in the hydrology and microtopography, indicating microhabitat partitioning. *Pogonia* was restricted to the wettest areas while *Calopogon* and *Arethusa* were found on drier sites.

Key Words: Peatland orchids, *Arethusa*, *Calopogon*, *Pogonia*, microhabitat, Newfoundland

INTRODUCTION

Peatlands are a significant vegetation type of Newfoundland, with 18 of the 32 species of Newfoundland orchids inhabiting these peatland environments. Various plants within a particular peatland may appear to be evenly distributed; however, upon closer inspection, the species is seen to have a specific distribution pattern. This pattern often reflects microhabitats within a peatland.

Differences in the growth rates of various peatland plants, especially *Sphagnum* spp. and sedges, create a hummocky terrain. These hummocks often remain above the watertable year-round, while in hollows the watertable is usually at the surface. The species within a peatland community are often distributed relative to the watertable. Thus, while cranberry (*Vaccinium macrocarpon* Ait.) and sheep laurel (*Kalmia angustifolia* L.) commonly co-occur on a particular peatland, the former species is distributed near the watertable while the latter is often confined to the drier hummocks (Wells, 1981).

Arethusa bulbosa L., *Calopogon tuberosus* (L.) BSP and *Pogonia ophioglossoides* (L.) Ker are three sympatric Newfoundland orchids which frequently grow on the peatlands of the Avalon Peninsula (Luer, 1975).

This study was undertaken to determine how these three species

are distributed when they co-occur. Do they partition the microhabitats of the peatlands they inhabit? Microhabitat partitioning is defined in this study by the species' distributions in relation to hydrology and microtopography of the peatland.

METHODS AND MATERIALS

Three study sites were located about 40 km west of St. John's, Newfoundland in the vicinity of the Witless Bay Line. Site 1: elevation 216 m; 47°22'00"N; 53°02'51"W; site 2: elevation 231 m; 47°20'35"N; 52°59'14"W; site 3: elevation 197 m; 47°20'19"N; 52°55'52"W. Two study sites were slope bogs, the most common peatland type on the Avalon Peninsula (Wells, 1981). These treeless bogs are rarely more than 2 m deep, with slopes from 5–15%. The watertable is usually at or near the surface. Underlying bedrock is mostly acidic; seepage waters are generally nutrient-poor.

The third study site was a ribbed fen, an uncommon peatland type on the Avalon Peninsula (Wells, 1981). These severely-wind-swept peatlands occur on exposed slopes, usually over 200 m in elevation. They are treeless and shallow, mostly less than 1 m in depth. Ribbed fens may contain exposed rock outcrops and glacial erratics. Flashets or small pools in ribbed fens are common and are oriented at right angles to the slope. These fens are generally more minerotrophic than slope bogs as the nutrients are released by high soil-frost activity and continual downslope water movement (Wells, 1976).

Field work was conducted from June to September, 1988. A 10 m² plot was delineated at each site and each plot was subdivided into 400 0.5 m² quadrats. *Arethusa*, *Calopogon* and *Pogonia* plants were counted and mapped, and elevation above the watertable was determined in each quadrat.

Microtopography of each plot was determined. Mean height above the watertable for the orchids was estimated with the surface of the nearest flashet taken to be height zero. This estimation was based on the quadrat's mean height for all quadrats containing at least one orchid species.

Two peat samples were taken from each plot. Since *Pogonia* was noted to occur separately from *Arethusa* and *Calopogon*, one sample was taken near a group of *Pogonia* and the other near a group of *Arethusa* and *Calopogon*. Cores were analyzed for nutrient content, pH and water content.

To determine if two orchid species within a site were distributed separately from one another, 0.5 m² quadrats that contained at least one individual were examined by a z-test (Wetherill, 1967). A z-score of 1.97 or higher was taken to indicate that the observed number of individuals of a species was significantly higher than expected for that quadrat. If over 5% of the total quadrats within a site showed significant z-scores, then the two species were taken to be significantly separate from each other.

RESULTS

Analysis of peat samples showed that the nutrient content was variable from site to site but pH and percent of available nitrogen were less variable. There was no significant relationship between the distribution of the three orchid species and availability of nutrients.

Based on z-scores, in sites 1 and 3, *Pogonia* was significantly clumped apart from *Arethusa* and *Calopogon*; *Calopogon* and *Arethusa* overlapped in their distribution. In site 2, none of the orchids was significantly separate from the others.

Mean water content of the substrate near *Pogonia* was 92.4% (range = 91.3–93.5%) at all sites. In sites 1 and 3, *Pogonia* was found to be restricted to the perimeters of flashets which had gently sloping sides (a slope of 1–2%). Site 2, however, had *Pogonia* abundant throughout, distributed from 1 to 11 cm above the watertable (mean = 4.9 cm, SD = 1.96). The frequency of quadrats containing *Pogonia* reached a maximum for those quadrats which were 5 cm above the watertable (Figure 1).

Calopogon and *Arethusa* were found close to steep-sided flashets and on the sides and tops of peat hummocks, especially at sites 1 and 3. At site 2, *Arethusa* was restricted to the few hummocks present but *Calopogon* was found in many of the depressions as well. The mean water content near these species was 78.2% (range = 75.4–80.7%).

Microtopography of site 1 had elevations ranging from 0 cm (surface of the flashets) to 36 cm above the watertable. Orchids of this site were restricted to 1 to 29 cm above the watertable. Sites 2 and 3 had elevations above the watertable ranging from 0 to 32 cm and 0 to 36 cm respectively. At site 2, orchids were restricted to 1 to 23 cm above the watertable while at site 3, they were distributed from 1 to 25 cm.

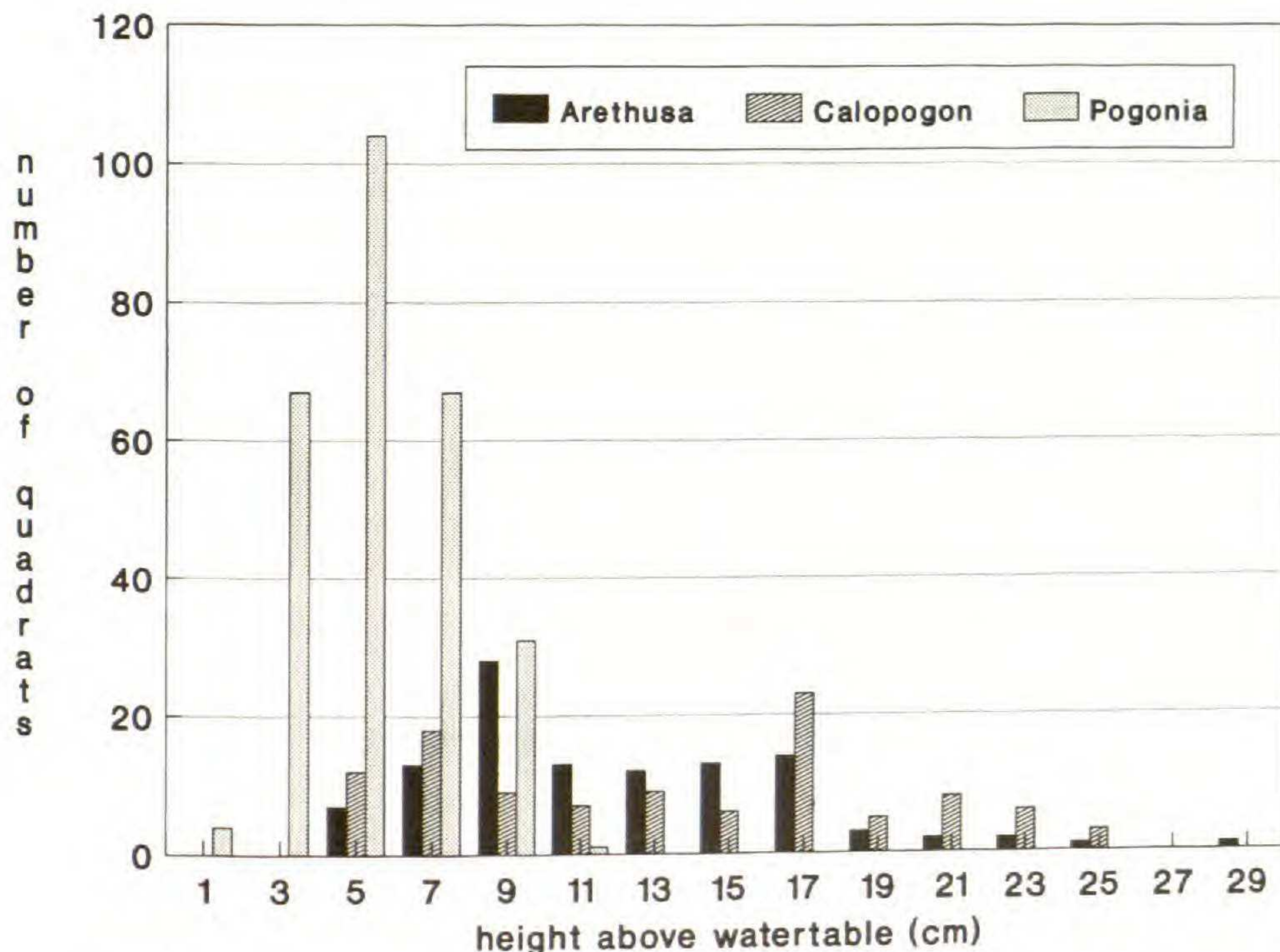


Figure 1. Frequency of quadrats containing *Arethusa*, *Calopogon* or *Pogonia* at various heights above the watertable.

Arethusa was found from 5 to 25 cm above the watertable (mean = 12.1 cm, SD = 4.72). The frequency of quadrats containing *Arethusa* reached a maximum for those quadrats which were 9 cm above the watertable (Figure 1).

Calopogon ranged from 5 to 29 cm above the watertable (mean = 12.9 cm, SD = 5.96). The two orchids had a bimodal distribution with the frequency of quadrats containing them peaking at 7 and 17 cm above the watertable (Figure 2).

DISCUSSION

Analysis of the nutrient content in areas of *Pogonia*, *Calopogon* and *Arethusa* within each site did not show any patterns. Distribution of orchids in these particular sites did not appear to be influenced by the availability of nutrients.

The distribution of *Pogonia* individuals in relation to the microtopography showed them to be mostly in the wettest areas of the three sites (mostly 3 to 9 cm above the watertable). *Calopogon* and *Arethusa* individuals were found close to steep-sided flashets

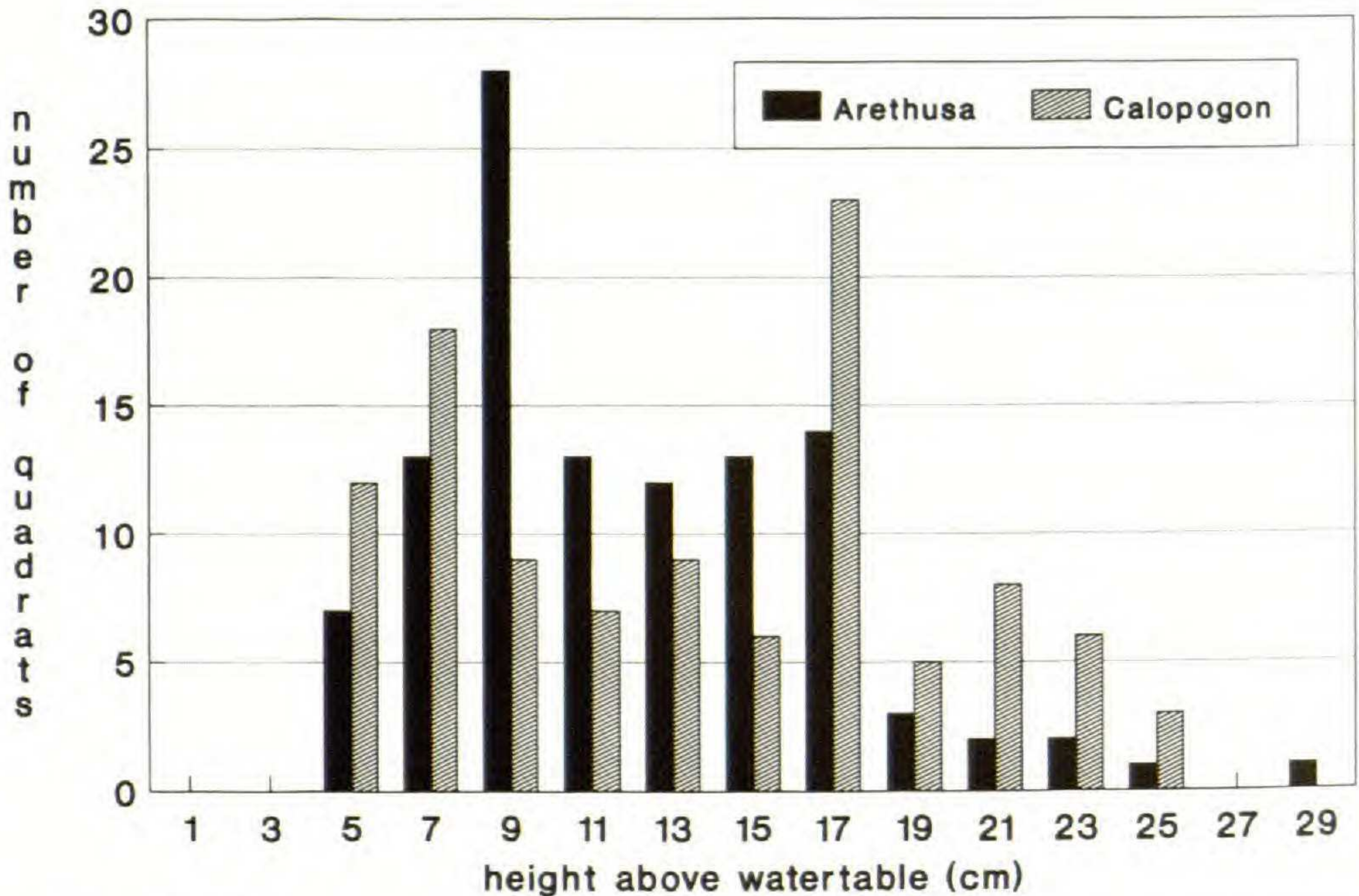


Figure 2. Frequency of quadrats containing *Arethusa* or *Calopogon* at various heights above the watertable.

but were mostly distributed in somewhat drier areas on the sides and tops of peat hummocks.

Case (1964) found all three species co-occurring in the Great Lakes region. He noted *Pogonia* as being most abundant in the wetter bogs and swamps, *Arethusa* frequently growing on sedge tufts among flashets as well as on isolated sphagnum hummocks, and *Calopogon* being common on the edge of hummocks and around the base of stunted spruce.

Petrie (1981) also noted that while these three orchids often co-occur, *Pogonia* was usually most common in the wettest part of a bog, and its orchid companions, although nearby, were mostly distributed in somewhat drier situations.

The distribution pattern of the orchids in this study can be partly explained by physical features of the orchid's root-systems. *Pogonia* individuals have a fine, fibrous root-system which grows superficially, thus *Pogonia* is not tolerant of drought conditions (Luer, 1975). Gentle shorelines of flashets and low depressions are the areas of a peatland which have the least possibility of becoming droughty. *Calopogon* and *Arethusa* have root-systems which bear small, rounded bulbous corms (Luer, 1975) which can act as water-storage organs. Thus, these orchids apparently can

tolerate the drier conditions found on the sides and tops of peat hummocks.

Statistics from this study show the distribution of *Pogonia* to be separate from *Calopogon* and *Arethusa*. The latter two orchids overlap in their distribution; mean height above the watertable for *Calopogon* and *Arethusa* was 12.9 cm and 12.1 cm, respectively. However, *Calopogon* and *Arethusa* were not evenly distributed throughout their overlapping microhabitat. Both orchids appear at 5 cm above the watertable. Below 9 cm and above 15 cm, *Calopogon* is the most abundant, while between 9 and 15 cm above the watertable, *Arethusa* is more common. While the differences in the distribution of *Calopogon* and *Arethusa* are subtle, the pattern of distribution found in this study suggests that *Calopogon* is more tolerant of wetter and drier conditions than is *Arethusa*.

Factors other than hydrology of these peatlands may be affecting distributions of *Calopogon* and *Arethusa* in particular. Further investigation is necessary to ascertain what other factors might affect the distribution of these orchids.

This study suggests that in eastern Newfoundland, hydrology is a major factor affecting partitioning of microhabitats for these three sympatric orchids. *Arethusa*, *Calopogon* and *Pogonia* have overlapping distributions throughout the northeastern United States and eastern Canada from the Great Lakes to Newfoundland. While hydrology may be a major factor affecting the partitioning of microhabitats for the three orchids throughout their geographic range, other factors may also affect their distribution within a given peatland.

These other factors may include the hydrology pattern of a particular peatland type. Watertable patterns may vary considerably between a ribbed fen and a basin bog (Wells, 1981). Different plant associations within a peatland site have different key species, which may prevent one or more of the orchids from becoming established. For example, Sheviak (1974) found *Pogonia* to be absent from areas where leatherleaf, *Chaemadaphne calyculata*, was present.

Throughout North America, much of the emphasis on orchid ecology is based on their pollination ecology (Thien and Marcks, 1972). Orchids which co-occur at a particular site are often studied to determine differences in their breeding systems. Few studies have been done on how the orchids co-exist, based on the ecology

of their particular site preferences. Such factors affecting the partitioning of microhabitats between sympatric orchids should be the subject of further investigations within the Orchidaceae.

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